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Segmental Anomalies in Some European Neobisiidae (Pseudoscorpiones, Arachnida)—Part I [1)]

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B. P. M. ĆURČIĆ [2)] : ヨーロッパ産コケカニムシ科(クモ綱:カニムシ目)の数種にみられる体節異常 第1報 [1)]

Abstract : Teratological variation in the segmental structure of the abdomen has been studied in five pseudoscorpion species of the European Neobisiidae, four from the genus *Neobisium* CHAMBERLIN and one species of the genus *Roncus* L. KOCH.

A total of 78 abnormal specimens have been found. These were dissected thoroughly and subjected to the pathomorphological analysis. It was found that the frequency of anomalous pseudoscorpions was variable, depending on the collection site, developmental stage and species. The following aberrations of sclerite segmentation have been noted : partial atrophy, hemimery, symphysomery, occurrence of a supernumerary sclerite (?), and different combinations of these anomalies.

Teratological variation of the abdominal sclerites has been confined mostly to adults, with the exception of a single tritonymph. Tergal anomalies have been much more frequent than those affecting sternites. It was also noted that segmental deficiencies occur more frequently in males than in females.

In addition, some generalizations on the relative distribution of segmental anomalies have been made. The possible causes of the origin of these deficiencies in the pseudoscorpions studied have been also briefly discussed.

Key words : pseudoscorpions, postembryonic development, teratology, abdominal deficiencies.

Introduction

Accidental variation in arachnids may readily be identified because the individuals involved deviate from normal specimens as to be recognised as freaks, or because they exhibit abnormalities which are asymmetrical (BALAZUC, 1948, 1967; DEMANGE, 1975; NAJT

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& Dalens, 1979).

Arachnids have been observed with different anomalies ranging from serious disturbances in the body plan to some minor deficiencies. Such abnormalities have been reported for scorpions, opilions, spiders, pseudoscorpions, and other related groups (Vachon, 1947, 1953 ; Chamberlin, 1949, Juberthie, 1964; Savory, 1977; Ćurčić, 1980).

Among arachnids, false scorpions have been found with segmentation deficiencies involving the dorsal and ventral sclerites. Such abnormalities have been described in *Ellingsenius sculpturatus* (Lewis) and *Anatemnus javanus* Thorell (With, 1905), *Dactylochelifer latreillei* (Leach) (Hadži, 1930; Gilbert, 1952), *Synsphyronus mimetus* Chamberlin (Chamberlin, 1949), *Horus granulatus* Ellingsen (Beier, 1955), and *Allochernes wideri* (C. L. Koch) (Weygoldt, 1969). Pedder (1965) has described further abnormalities in *D. latreillei* and listed others for *Chthonius tenuis* (L. Koch), *Neobisium maritimum* (Leach), *N. muscorum* (Leach), *Lamprochernes nodosus* (Schrank) and *Allochernes dubius* (O. P. -Cambridge).

In the Neobisiidae, a number of segmental anomalies have been recorded from *N. erythrodactylum* (L. Koch) (Kästner, 1927), *N. maritimum* and *N. muscorum* (Pedder 1965). Only recently, comparative aspects of teratological variation have been studied in other neobisiid species : *N. carpaticum* Beier, *N. macrodactylum* (Daday), *N. cephalonicum* (Daday), *N. sylvaticum* (C. L. Koch), *N. fuscimanum* (C. L. Koch), and *Roncus lubricus* L. Koch (Ćurčić, 1980 ; Ćurčić & Dimitrijevic, 1981, 1984, 1985, 1986 ; Ćurčić, Krunić & Brajković, 1981, 1983). These studies have revealed the outstanding heterogeneity of segmental anomalies affecting abdominal sclerites. For example, there may be partial or total fusion of two or more segments (partial or total symphysomery-single or multiple), the spiral alignment of segment halves (single or multiple helicomery-monocyclical or polycyclical, dextral or sinistral), the omission of a segment half (hemimery-single or multiple), reduction in part of a sclerite (hemiatrophy or partial atrophy-single or multiple), the enlargement of a sclerite (single or multiple), the omission of a sclerite, or the occurrence of a supernumerary tergite or sternite. In addition, different combinations of these anomalies may be present in a single pseudoscorpion specimen.

The primary aims of this study were to make :

-a quantitative and qualitative analysis of the variation of segmental anomalies in four European species of *Neobisium* Chamberlin and one species of *Roncus* L. Koch from different sites ;

-an analysis of the frequency of different tergal and sternal anomalies in the postembryonic stages of each pseudoscorpion species ;

-an analysis of the correlated (common) occurrence of different segmental anomalies ; and

-an analysis of the possible factors that sparked the origin and development of such anomalies in the pseudoscorpions studied.

Material and Methods

We have analysed the accidental and teratological variation of abdominal deficiencies in the population samples of *N. carpaticum* from five sites : Košutnjak Park, Topčider Park, Mt. Avala and Sremčica, all near Belgrade, Yugoslavia, and from Deliblatska Peščara (Devojački Bunar) near Pančevo, Yugoslavia ; of *N. sylvaticum* from Topčider Park and Mt. Avala, and of *N. fuscimanum, N. cephalonicum* and *Roncus lubricus* from Mt. Avala only. The numbers of specimens collected in these localities are presented in Tables 1 and 2.

Samples of all the pseudoscorpion species under study were obtained by sifting leaf-litter and humus over a period running from October 1984 to November 1986. The plant associations in the localities where we collected pseudoscorpoins are characterized by the specific vegetation structure :

-Košutnjak Park : remnants of an oak and lime forest,

-Topčider Park : remnants of an oak forest with rare beeches,

-Mt. Avala : a mixed oak and hornbeam forest with rare elms and beeches,

-Sremčica : an introduced oak forest with rare black pines and false acacias, and

-Deliblatska Peščara (Devojački Bunar) : remnants of a forest-steppe vegetation, involving a mixed oak and lime forest with introduced false acacias and Bachofens' poplars, fustets and junipers.

After dissecting, all specimens collected have been mounted in the gum chloral medium (Swan's fluid) and thoroughly examined. The terminology for the segmental anomalies in this study is the same used for other arthropods (Balazuc 1948, 1967). It has been somewhat modified by Ćurčić *et al.* (1983) and Ćurčić & Dimitrijević (1986) to include the whole range of sternal and tergal deficiencies which were observed in pseudoscorpions.

Results

A total of 78 abnormal specimens were found (Tables 3 and 4) -61 of *N. carapaticum*, eight of *N. sylvaticum,* two of *N. fuscimanum,* two of *N. cephalonicum,* and five of *R. lubricus.* The analysis of teratological variation of segmental anomalies in the pseudoscorpions studied has revealed the following results :

Neobisium carpaticum

Topčider Park

Male (Fig. 1A). Small sections of tergites IV–VIII are missing on the left. In addition,

part of tergite VI is missing on the right. Multiple partial atrophy.

Male (Fig. 1B). Parts of tergite III and IV are missing. The setal formula of tergites III and IV is unaltered. Multiple partial atrophy.

Male (Fig. 1C). The left part of tergite III is almost completely missing and the setae are unequally distributed. Tergite IV is enlarged and partially fills the space where the missing part of tergite III would otherwise be found. Partial atrophy and tergite enlargement.

Male (Fig. 1D). The left anterior part of tergite I is without pigmentation. Partial atrophy.

Male (Fig. 1E). The central anterior part of tergite IV is without pigmentation. Partial atrophy.

Male (Fig. 1F). Anterior part of tergite I is missing. As a consequence of this deficiency, the setal distribution is unequal and tergite II is slightly enlarged backwards. Partial atrophy and tergite enlargement.

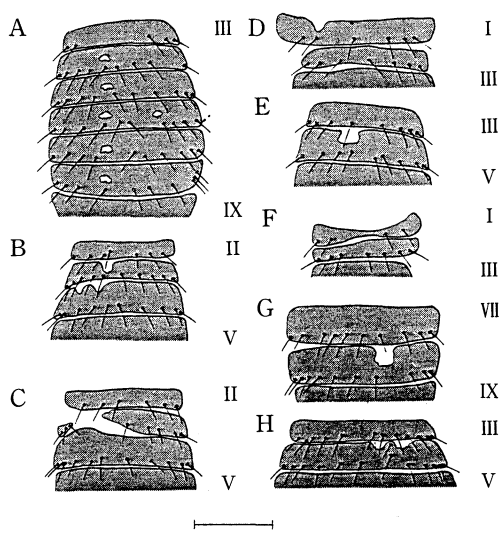

Fig. 1 *Neobisium carpaticum* Beier, 1934. Topčider Park. Scale line=0.5mm. −A, tergites III−IX, male. −B, tergites II−V, male. −C, tergites II−V, male. −D, tergites I−III, male. −E, tergites III−V, male. −F, targites I−III, male. −G, tergites VII−IX, male. −H, tergites III−V, male.

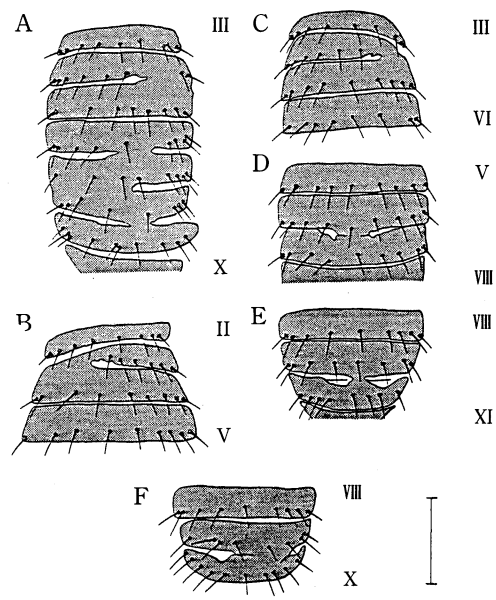

Fig. 2 *Neobisium carpaticum* Beier, 1934. Topčider Park. Scale line=0.5mm. −A, tergites III−X, male. −B, tergites II−V, male. −C, tergites III−VI, male. −D, tergites V−VIII, male. −E, tergites VIII−XI, male. −F, tergites VIII−X, male.

Male (Fig. 1G). The right anterior part of tergive VIII is missing. There is no pigmentation in the affected area. The distribution of setae on tergite VIII is unequal. Partial atrophy.

Male (Fig. 1H). The right antherior part of tergite IV is without pigmentation. A single seta appears at the anterior tergal margin. Partial atrophy.

Male (Fig. 2A). In this case, the tergal abnormalities affect six tergites. First, tergites IV and V are fused on right. Second, tergites V－VIII have fused together. As a result of this anomaly, the number of setae on tergites V－VIII is reduced, and their distribution is altered if compared with the values for normal *N. carpaticum* (ĆURČIĆ, 1982). Multiple symphysomery.

Male (Fig. 2B). In this specimen, tergite III is reduced and fused with tergite IV on the left. On tergite III, the number of setae is less than in normal specimens. Partial atrophy and symphysomery.

Male (Fig. 2C). Tergites IV and V are fused on the right, hence the irregular setation of tergite IV. Symphysomery.

Male (Fig. 2D). Tergites VI and VII have fused in the mid-region. Symphysomery.

Male (Fig. 2E). Tergites IX and X of this specimen are also fused in the mid-region. As a consequence, the setae on tergite X are unequally distributed. Symphysomery.

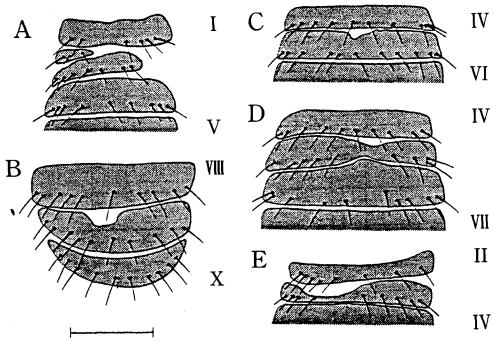

Fig. 3 *Neobisium carpaticum* BEIER, 1934. Topčider Park. Scale line=0.5mm. －A, tergites I－V, female. －B, tergites VIII－X, female. －C, tergites IV－VI, female. －D, tergites IV－VII, female. －E, tergites II－IV, female.

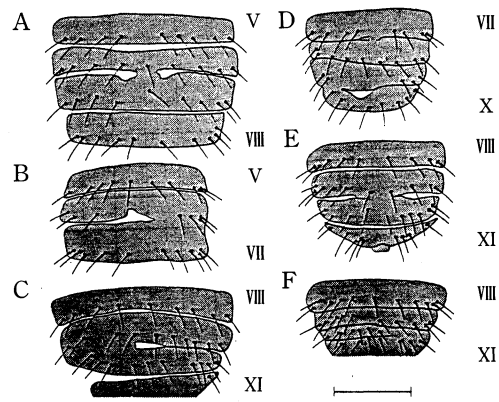

Fig. 4 *Neobisium carpaticum* BEIER, 1934. Topčider Park. Scale line =0.5mm. －A, tergites V－VIII, female. －B, tergites V－VII, female. －C, tergites VIII－XI, female. －D, tergites VII－X, female. －E, tergites VIII－XI, female. －F, tergites VIII－XI, female.

Male (Fig. 2F).In this case, tergites IX and X have partially fused. Symphysomery.

Female (Fig. 3A). Sections of tergites II and III are missing on the right. The anterior part of the tergite IV is enlarged to fill part of the space left vacant in tergite III. Multiple hemimery and tergite enlargement.

Female (Fig. 3B). The mid-anterior part of tergite IX is without pigmentation. Partial

atrophy.

Female (Fig. 3C). The mid-anterior part of tergite V is absent. Partial atrophy.

Female (Fig. 3D). Tergite V is constricted in the mid-region. The central anterior part of the tergite VI is enlarged to fill part of the space vacant in tergite V. As a consequence, the mid-region of sternite V is free of setae. Partial atrophy and tergite enlargement.

Female (Fig. 3E). Part of tergite III is missing on the left. The mid-region of this tergite lacks setae. Partial atrophy.

Female (Fig. 4A). Tergites VI and VII are partially fused in the mid-region. The setae are concentrated on the right and left parts of tergite VII. Symphysomery.

Female (Fig. 4B). Tergites VI and VII are fused from the right to the mid-region. Symphysomery.

Female (Fig. 4C). Tergites IX and X have partially fused from the left to the mid-region. Symphysomery.

Female (Fig. 4D). In this case, the tergal anomalies affect four tergites. Tergites VII and VIII have partially fused in the mid-region, and tergites IX and X have partially fused on the left. As a consequence, the setae on tergites VII and IX are few in number, unequally distributed, and completely lacking in the mid-region. Multiple symphysomery.

Female (Fig. 4E). In this specimen, tergites IX and X are fused in the mid-region. The distribution of setae on tergites IX and X is altered in relation to normal variation of this characteristic (Ćurčić, 1982). Symphysomery.

Female (Fig. 4F). Tergites X and XI of this specimen are fused on the right. In addition, the setae on tergite X are concentrated on the left. Symphysomery.

Košutnjak Park

Male (Fig. 5A). In this specimen, part of tergite II is missing on the right. Partial atrophy.

Male (Fig. 5B). The mid-posterior part of tergite III is missing. Partial atrophy.

Male (Fig. 5C). Tergite V lacks a part of its mid-region. Tergite IV is enlarged backwards. Partial atrophy and tergite enlargement.

Female (Fig. 5D). The mid-region of tergite IV and a small part of tergite V on the right are without pigmentation. The central region of tergite IV lacks setae. Multiple partial atrophy.

Male (Fig. 5E). On tergite VI, two anterior parts are missing on the right. Partial atrophy.

Male (Fig. 5F). The left anterior part of tergite IV is without pigmentation. The setal formula of this tergite is unaltered. Partial atrophy.

Male (Fig. 6A). The left half of tergite III is missing. Hemimery.

Female (Fig. 6B). Parts of tergite IV are missing. There is no pigmentation in the affected area. As a consequence, we found a reduced number and unequal distribution of

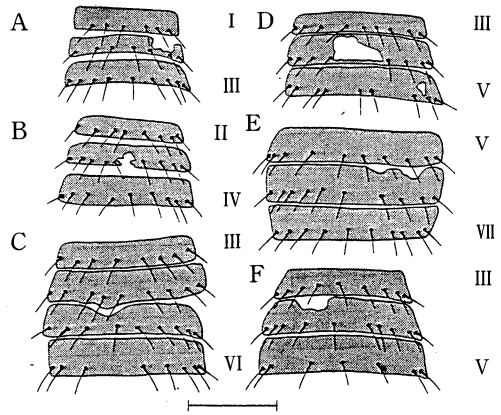

Fig. 5 *Neobisium carpaticum* Beier, 1934. Košutnjak Park. Scale line=0.5mm. −A, tergites I −III, male. −B, tergites II−IV, male. −C, tergites III−VI, male. −D, tergites III−V, female. −E, tergites V−VII, male. −F, tergites III−V, male.

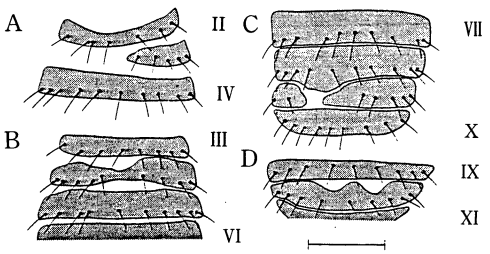

Fig. 6 *Neobisium carpaticum* Beier, 1934. Košutnjak Park. Scale line=0.5mm. −A, tergites II−IV, female. −B, tergites III−VI, female. −C, tergites VII−X, female. −D, tergites IX−XI, female.

setae. Partial atrophy.

Female (Fig. 6C). Part of tergite IX is completely absent. Tergite VIII is enlarged in its mid-region and fills the space where the missing part of tergite IX would otherwise be found. The setae on tergite IX are missing from the mid-region of this sclerite. Partial atrophy and tergite enlargement.

Female (Fig. 6D) The central anterior parts of tergite X are missing. Partial atrophy.

Male (Fig. 7A). Tergites III and IV have fused on the left. Thus the relative distribution of setae on tergite III is altered. Symphysomery.

Male (Fig. 7B). Tergites V and VI have partially fused on the left. The setal formula shows a reduction in the number of setae on both tergites. Symphysomery.

Male (Fig.7C). Tergites III andIV have partially fused on the left. The setal formula is altered (the setae are concentrated on the right half of the tergite). Symphysomery.

Male (Fig. 7D). Tergites V and VI have fused on the right. The setae on tergite V are unequally distributed. Symphysomery.

Male (Fig. 7E). In this specimen, tergites VI and VII have almost completely fused from the left to the right. The setal formula is altered and the mid-region of tergite VI is free of setae. Symphysomery.

Male (Fig. 7F). Tergites VII and VIII have fused from the right to the middle. The consequence of this anomaly is the reduction in the number of setae. The mid-region of tergite VII is free of setae. Symphysomery.

Male (Fig. 8A). In this specimen, tergites VI and VII have fused on the left. Symphysomery.

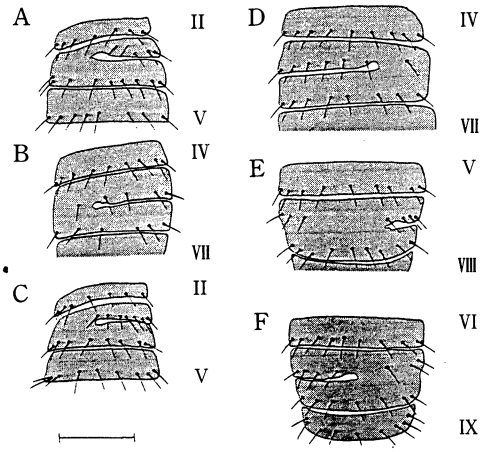

Fig. 7 *Neobisium carpaticum* Beier, 1934. Košutnjak Park. Scale line=0.5mm. −A, tergites II−V, male. −B, tergites IV−VII, male. −C, tergites II−V, male. −D, tergites IV−VII, male. −E, tergites V−VIII, male. −F, tergites VI−IX, male.

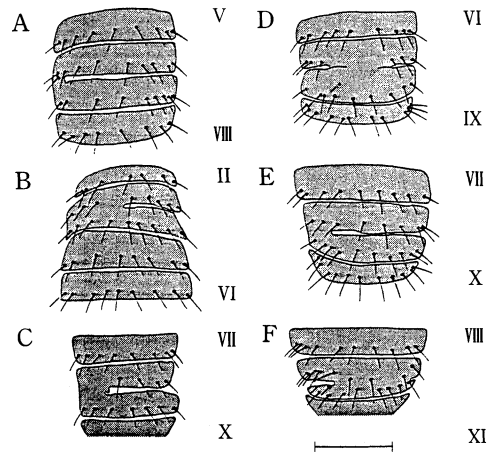

Fig. 8 *Neobisium carpaticum* Beier, 1934. Košutnjak Park. Scale line=0.5mm. −A, tergites V−VIII, male. −B, tergites II−VI, male. −C, tergites VII−X, female. −D, tergites VI−IX, male. −E, tergites VII−X, male. −F, tergites VIII−XI, male.

Male (Fig. 8B). The tergal deficiencies affect three tergites. Tergites III and IV have fused from the left to the mid-region, and tergite V is enlarged in its left part. Symphysomery and tergite enlargement.

Male (Fig 8C). Tergites VIII and IX have partially fused on the left. As a consequence, the left half of tergite VIII is free of setae. Symphysomery.

Male (Fig. 8D). Tergites VII and VIII are fused in the mid-region. As a consequence of this deficiency, the mid-region of tergite VII is completely free of setae. Symphysomery.

Male (Fig. 8E). Tergites VIII and IX have fused on the left. Symphysomery.

Male (Fig. 8F). In this case, tergites IX and X have almost completely fused. As a consequence, the number of setae is reduced and their relative position is altered. Symphysomery.

Mt. Avala

Female (Fig. 9A). The anterior mid-region of tergite VIII is completely missing. Partial atrophy.

Female (Fig. 9B). A deficiency is found in tergite I manifested by the absence of most of the left half of the sclerite. This anomaly has caused the unequal distribution of setae. Hemimery.

Female (Fig. 9C). In this case, a deficiency is found in tergite III manifested by the absence of most of the right half of the sclerite. This anomaly has caused the unequal distribution of setae. Tergite IV is enlarged in its mid-region and fills the central space where the missing part of tergite III would otherwise be found. Hemimery and tergite

enlargement.

Male (Fig. 9D). Anterior parts of tergite II are missing on the right. As a consequence of this aberration, the setal distribution on tergites I and II is unequal. Partial atrophy.

Male (Fig. 9E). Tergites V and VI are anomalous. The left part of tergite V is missing. Tergite VI is enlarged on the left to fill part of the space left vacant in tergite V. The setal formula of tergite VI is altered. Hemimery and tergite enlargement.

Male (Fig. 9F). The part of tergite III on the right is missing. As a consequence, tergite IV is slightly enlarged anteriorly. The setae on tergite III are concentrated on two isolated tergal sections. Partial atrophy and tergite enlargement.

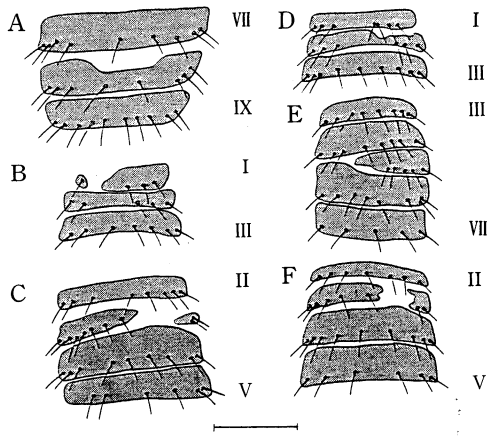

Fig. 9 *Neobisium carpaticum* Beier, 1934. Mt. Avala. Scale line: 0.5mm. −A, tergites VII−IX, female. −B, tergites I−III, female. −C, tergites II−V, female. −D, tergites I−III, male. −E, tergites III−VII, male. −F, tergites II−V, male.

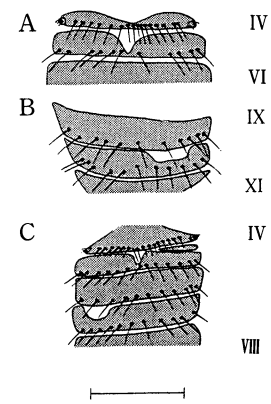

Fig. 10 *Neobisium carpaticum* Beier, 1934. Scale line =0.5mm. −A, sternites IV−VI, male, Mt. Avala. −B, sternites IX−XI, male, Sremčica. −C, sternites IV−VIII, male, Sremčica.

Male (Fig. 10A). Central parts of sternites IV and V are missing. The setation is unchanged. Partial atrophy.

Sremčica

Male (Fig. 10B). The anterior part of sternite X is missing on the right. The setal formula is unaltered. Partial atrophy.

Male (Fig. 10C). In this specimen, a supernumerary sternite (?) (between sternites IV and V) is represented by a small sclerite section on the left (carrying no setae). In addition, sternite V has a mid-anterior groove with no pigmentation. On sternite VII, anterior part is missing on the right. Multiple partial atrophy (and the occurrence of a supernumerary sclerite?).

Tritonymph (Fig. 11). The right half of tergite V is missing. The adjacent part of

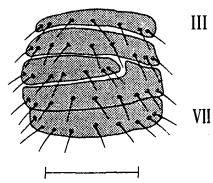

Fig. 11 *Neobisium carpaticum* Beier, 1934. Sremčica. Scale line=0.5mm. Tergites III–VII, tritonymph.

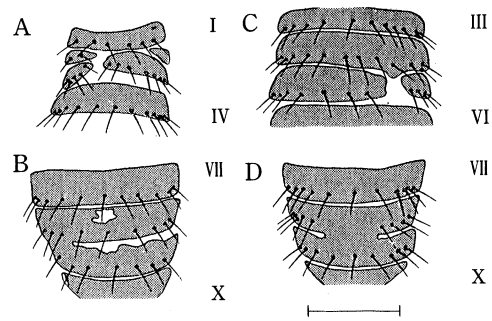

Fig. 12 *Neobisium carpaticum* Beier, 1934. Deliblatska Peščara. Scale line=0.5mm. – A, tergites I–IV, male. –B, tergites VII–X, male. –C, tergites III–VI, female. –D, tergites VII–X, male.

tergite VI is enlarged and partially fills the gap left by the missing half of tergite V. The setae are concentrated on the left half of tergite V. Hemimery and tergite enlargement.

Deliblatska Peščara

Male (Fig. 12A). The mid-regions of tergites II and III are missing. This anomaly has caused the unequal distribution of setae. On the right, the small section of tergite II is free of setae and the remaining part of this sclerite (on the left) has two setae only. Multiple partial atrophy.

Male (Fig. 12B). In this specimen, the mid-section of tergite VIII and the right anterior margin of tergite IX are missing. These areas lack pigmentation. In addition, tergites VIII and IX have fused on the left. However, the setal formula is unchanged. Partial atrophy and symphysomery.

Female (Fig. 12C). In this case, a deficiency is found in tergite V manifested by the absence of the section of this sclerite on the right. On the right, the setae are concentrated on the small section of tergite V. Tergite IV is enlarged on the right and fills partially the space where the missing part of tergite V would otherwise be found. Partial atrophy and tergite enlargement.

Male (Fig. 12D). Tergites VIII and IX are fused in the mid-region. This anomaly has caused the alteration of the setal formula, hence the central region of the tergite VIII is free of setae. Symphysomery.

(To be continued in *Acta Arachnologica*, vol. 38, fasc. 1)

B. P. M. Ćurčić

摘　　要

ヨーロッパ産コケカニムシ科の5種(コケカニムシ属4種とツノカニムシ属1種)の腹部体節にみられる奇形的な変異について研究した。異常な体節構造を示した個体が計78個体得られ、これらを解剖して病理形態学的な分析に供した。

その結果、体節異常を示す個体の頻度は採集場所、発育段階および種によって異なることがわかった。腹背板の変異には次のようなものが認められた。即ち、部分的萎縮、半分欠如、融合、腹背板数の過剰、およびこれらのさまざまな組み合わせである。腹背板の奇形的変異の出現は主として成虫に限られ、第三若虫の例が一つだけあった。腹板の異常よりは背板の異常のほうがはるかに多く見られた。また、体節欠如は雌よりも雄で多く見られた。更に、体節異常の相対的分布についていくつかの一般化を行い、カニムシ類の体節欠如の原因を推定した。